Space Weather Technical Forecast

Issued on Monday, 22 November 2021 at 13:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the last 24 hours, with no significant X-ray flare activity observed at GOES-16. There are two active sunspot regions on the visible disc, both small and stable: AR2896, which is classified as Hsx/Alpha, and AR2897, which underwent slight decay to become an Axx/Alpha.

There are currently two large filaments in southeastern disc, but these appear to be stable at the time of writing. There were some changes in the shape and appearance of coronal hole 21 near the northern crown through the 21st November, perhaps explaining changes seen in a streamer on STEREO A COR2, although this is angled above the ecliptic plane and not expected to affect Earth. In addition to this, there was two small Coronal Mass Ejections (CMEs) seen leaving the northwestern limb at around 21/2100UTC, and the southeastern limb at around 22/0430 UTC, however both of these are expected to be non-Earth directed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, remained characteristic of connection to a strong negative polarity high speed stream, most likely that emanating from coronal hole 20. Solar wind speeds peaked at 670 km/s at 21/1336 UTC and then have generally declined through the period to around 560 km/s. The solar wind density was average throughout, between 6 and 10 ppcc. The interplanetary magnetic field strength (IMF) Bt, was weak (<8 nT), with a north-south component varying between -5 and +5 nT. The phi angle was predominately negative (towards the Sun) throughout. Resultant geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained at Background levels. The high energy electron flux (greater than 2 MeV) continued to fluctuate between background and moderate levels, peaking at 712 pfu at 21/1515UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), but with a very slight increasing trend. At midnight (22/0000 UTC) 1.5e7 integrated pfu was observed.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with only a slight chance of C-class flares due to the two small and simple sunspots on the Earth-facing disc.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the current forecast. Over the next couple of days Earth's interaction with the fast wind of CH20 is expected to wane and geomagnetic activity is to decrease from Quiet to Unsettled, with periods of Active, to become predominantly Quiet. However, further enhancement in the solar wind is likely later in the forecast period as coronal hole 21 moves to a geoeffective position. Activity is likely to become Unsettled again, with a chance of Active intervals and a slight chance of a G1/Minor Geomagnetic Storm.

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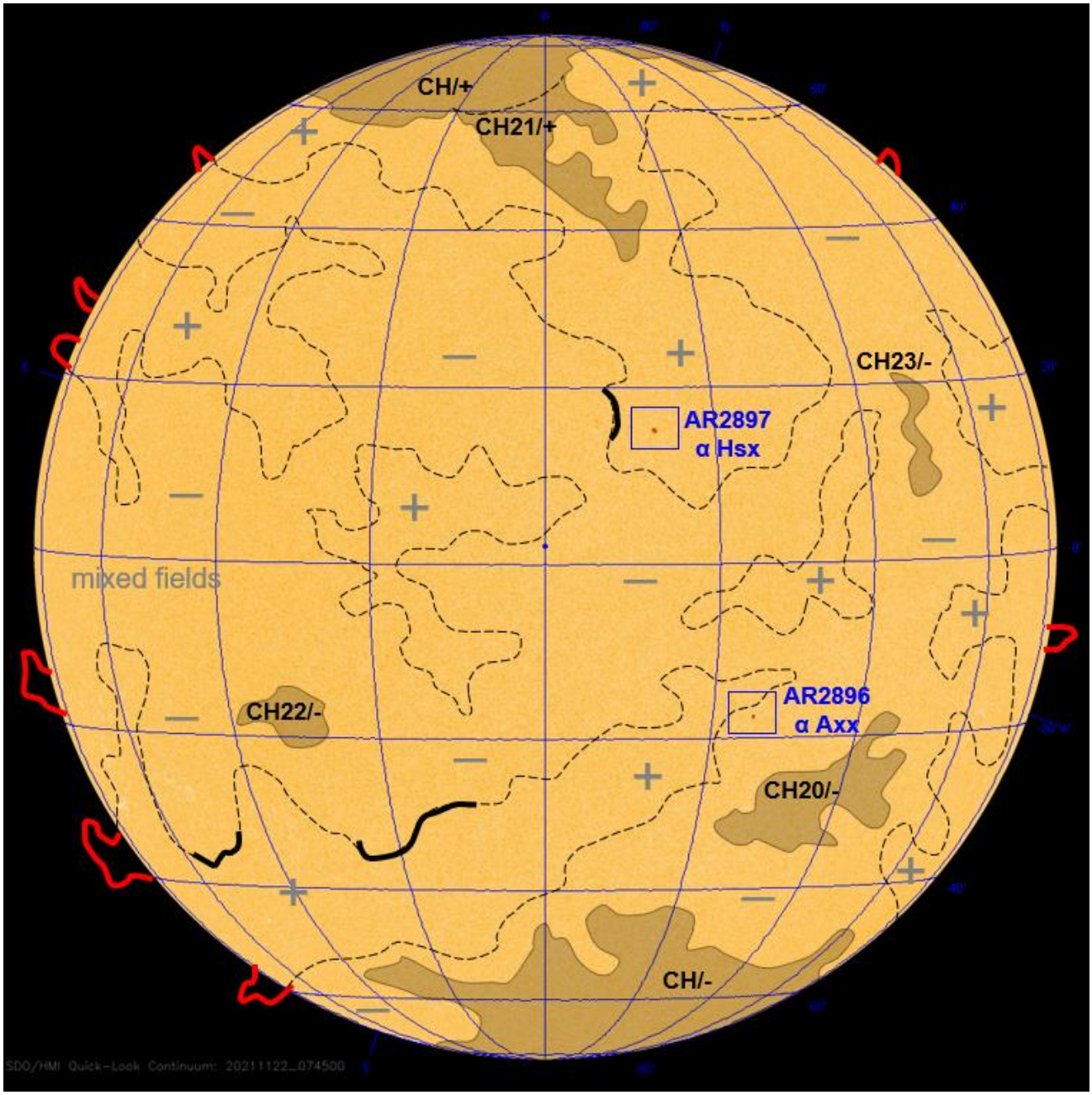
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels. The high energy electron flux (greater than 2 MeV) is expected to rise as geomagnetic activity wanes from the current elevated solar wind. The magnitude of this rise is uncertain, however diurnal oscillations peaking at High flux (greater than 1000 pfu) are likely. The associated 24-hour integrated fluence has a chance of breaching Active (greater than 1e8 integrated pfu) in the period, but more likely remaining just below this level.

Figure 1. Solar Analysis Valid 22/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in the current forecast.
The fast wind from coronal hole 20 is likely to be the main driver of any enhanced geomagnetic activity in the coming days, as the effects of this coronal hole wane. Beyond this feature, a new unnumbered coronal hole appears to have opened in the northwest of the disc in the past 24 hours, however as a visibly rather tenuous entity, this is not expected to have a notable impact on the forecast. In terms of the longer range, CH21/+, the southern extension of the northern crown, is likely to produce an enhancement in the solar wind towards the end of day 3 (24th) into day 4 (25th).
Despite solar wind speeds of near 700km/s being observed at L1 at the peak of CH20/-, geomagnetic activity remained more muted than expected. Quiet to Unsettled activity is therefore expected to start, with Active periods possible. Activity is expected to become mainly Quiet through day 2 (23rd). However, later in the forecast period geomagnetic activity is likely to increase to Unsettled levels again, with a chance of Active intervals and a slight chance of a G1/Minor geomagnetic storm.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL.

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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

There are currently two active sunspot active regions on the visible disc: AR2896. which has been analysed as Hsx/Alpha; and AR2897, which is now considered to be an Axx/Alpha. Both regions are small, magnetically simple and have remained stable.
STEREO A EUVI 195 imagery hints that Ex-2891 may lie narrowly over the eastern limb, perhaps impacting on probabilities of flares into the new week, although for now Very Low solar activity is forecast, with a daily Slight Chance (5%) of C-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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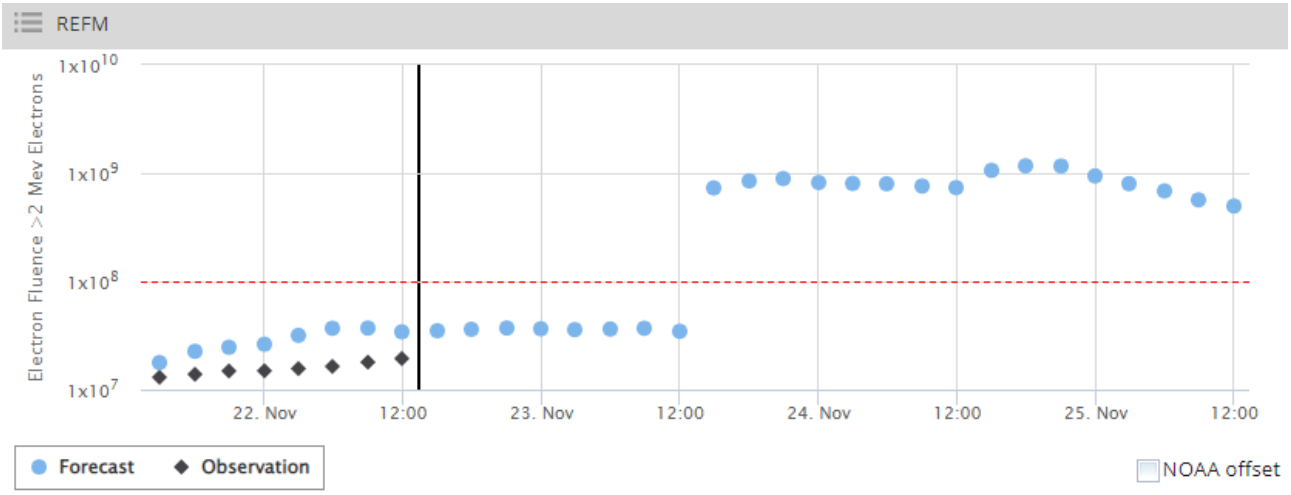
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO has been diurnally fluctuating between background and moderate levels in response to the elevated winds in association with coronal hole 20 (CH20/-). This pattern is likely to continue over the coming days but with an increased chance of High levels (> 1000 pfu) being reached as any compression of the Van Allen belts from the current fast wind of CH20/- subsides. However, towards the end of the forecast period flux is likely to become suppressed as coronal hole 21 becomes geoeffective and geomagnetic activity increases. Corresponding electron fluence is expected to see an increasing trend over the next 3 days and there is a chance that the Active threshold (>1e8 integrated pfu) will be exceeded during this period. On day 4 (25th) it is likely that electron fluence levels will drop again.
MOSWOC REFM indicates an increasing risk of breaching Active in the next 48 hours, although the muted geomagnetic response to the fast wind from CH20/- suggests that this risk is lower than REFM signals.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	20	30	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: Observed GOES 16 electron fluence and MOSWOC REFM data.



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